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Maternal Emotional Distress and Infant Sleep: A Longitudinal Study From Pregnancy Through 18 Months

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This longitudinal study examined whether changes in maternal emotional distress (depressive, anxiety, and parenting-stress symptoms) predict changes over time in subjective and objective infant sleep. We recruited 226 Israeli expectant mothers (*M* age 28.8 ± 3.3), most representing the middle-upper socioeconomic class. Maternal depressive and anxiety symptoms were assessed in the third trimester of pregnancy. After delivery (3, 6, 12, and 18 months), infant sleep quality and duration were assessed for 5 nights using actigraphy and the Brief Infant Sleep Questionnaire. Maternal depressive and anxiety symptoms were reassessed, and maternal parenting-stress was measured at all postpartum assessments. The findings demonstrated significant correlations between maternal emotional distress and mothers' subjective ratings of infant sleep problems (*r*s >.16 and < .46). Latent trajectory analyses indicated no significant effects of changes in maternal emotional distress variables on changes in infant subjective or objective sleep. Post hoc power analyses demonstrated that we had enough statistical power to reject the null hypothesis. The results suggest that mothers with higher emotional distress symptoms—and especially those with parenting-stress symptoms—are more likely to experience their infant's sleep as problematic. However, our results challenge the assumption that maternal emotional distress symptoms contribute to infant sleep disturbances over time. The findings are relevant to mothers with mild to moderate emotional distress symptoms and must not be generalized to mothers who experience major clinical depression. Future studies should evaluate whether maternal emotional distress interacts with other risk factors, such as infant temperament, to predict infant sleep disturbances.

Keywords: actigraphy, depression, infant sleep, longitudinal, maternal emotional distress

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The evolution of sleep consolidation is one of the main developmental processes during infancy (El-Sheikh & Sadeh, 2015). Brief awakenings during the night are a natural phenomenon characterizing the sleep of most infants and children. However, problems in the process of nighttime sleep consolidation, manifested in multiple night-wakings and in the inability to resume sleep without parental help, characterize 10% to 30% of all infants and toddlers (Bruni et al., 2014; Honaker & Meltzer, 2016; Hysing et al., 2014; Mindell et al., 2006). Left untreated, these sleep disturbances may be quite persistent and may have a negative impact on children's cognitive, behavioral, and emotional functioning (Bates et al., 2002; Sadeh et al., 2014; Sadeh et al., 2015). According to the transactional model of infant sleep development (Sadeh & Anders, 1993), the development of infants' sleep problems is influenced by a complex matrix of physiological (e.g., health problems, temperament) and psycho-social factors (e.g., culture, parenting, parent-infant relationship). Among these factors, parents have a critical role, and parental emotional distress (e.g., depression, anxiety) has been suggested as a main contributing factor to the development of behavioral sleep problems in infants (Sadeh et al., 2010; Teti & Crosby, 2012).

To date, most of the research on parental emotional distress in relation to infant sleep has focused on maternal prenatal or postnatal depression/depressive symptoms. As to prenatal depression, a few studies have demonstrated that newborns and young infants born to mothers with clinical prenatal depression were more likely to exhibit objectively assessed sleep disturbances, compared with infants born to healthy mothers. Specifically, in a study of 18 young infants (i.e., newborns to six-month-olds), infants born to depressed mothers were found to exhibit less efficient and more fragmented sleep as assessed with actigraphy, compared with infants born to women with no history of depression (Armitage et al., 2009). A different study that investigated sleep architecture in newborns and 6-month-old infants found more awake time, shorter

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sleep time, and alterations in the proportion of non-REM and REM sleep, assessed with polysomnography in infants born to depressed mothers compared with controls (Bat-Pitault et al., 2017). Moreover, newborns of depressed mothers who were observed during sleep, spent less time in deep sleep and more time in indeterminate (disorganized) sleep (Field et al., 2007). It has been postulated that depressed pregnant mothers demonstrate increased cortisol levels and that the fetus might be exposed to changes in the hypothalamic pituitary adrenal axis that may put the infant at risk of developing regulatory problems, including sleep problems (Armitage et al., 2009; Stein et al., 2014). Although these studies did not directly assess biological changes in the fetus, the underlying assumption was that sleep changes in newborns are not yet likely to be influenced by maternal postnatal behavior and, thus, could possibly be attributed to fetal exposure. However, not all studies on sleep in infants of depressed pregnant women demonstrate significant changes. In a study comparing infants born to depressed and control women, maternal prenatal depression and antidepressant use were not significant predictors of infant sleep problems, as reported by the mother, in 6- and 12-month-old infants (Galbally et al., 2018).

Other studies examined whether maternal prenatal depressive symptoms (and not a diagnosed depressive disorder) predict later infant sleep problems. Most of these studies are large cohort studies, and, although statistically significant associations between prenatal depressive symptoms and parental reports of early childhood sleep problems are usually reported, the effect sizes tend to be small. Moreover, there is no consistency regarding the sleep variables found to be associated with maternal depressive symptoms (Morales-Muñoz et al., 2018; Netsi et al., 2015; O'Connor et al., 2007; Toffol et al., 2019). For instance, in one study prenatal depressive symptoms predicted maternal reports of longer sleep-onset latency and irregular sleeping routines in three-month-old infants (Morales-Muñoz et al., 2018), whereas another study found that prenatal depressive symptoms were related to total reported sleep problems at 18 and 30 months of infant age. However, no evidence was found for significant links with measures of sleep fragmentation (e.g., number and length of night-wakings), after controlling for postnatal depression (O'Connor et al., 2007). Yet, another study found that prenatal depressive symptoms predicted shorter sleep duration and a higher number of awakenings, which were reported by the parents, but only in boys with a more reactive temperament at 18 and 24 months of age (Netsi et al., 2015).

Interestingly, there are almost no studies that have investigated sleep problems in infants of mothers with postpartum clinical depression. This is surprising in light of the high prevalence of postpartum depression (PPD) which is estimated to stand at 10% to 15% (Howard et al., 2014; Ross et al., 2005). In the only study that, to the best of our knowledge, examined the relations between maternal clinical depression in the postpartum and infant sleep, the rate of clinically significant depression scores was about double in mothers of night-waking infants than in mothers whose infants did not awaken during the night at 6 months postpartum (Karraker & Young, 2007). In addition, in a study of women with a history of clinical depression, disturbed infant sleep, as reported by the mother, at 6 weeks was associated with a higher depression score at 6 and 16 weeks postpartum (Sharkey et al., 2016).

Most of the studies on maternal postnatal mood in relation to infant sleep have examined whether mothers with elevated depressive symptoms are more likely to have infants with sleep problems. Findings from these studies typically demonstrate significant associations (Goldberg et al., 2013; Gress-Smith et al., 2012; Gueron-Sela et al., 2017; Hiscock & Wake, 2001; Hughes et al., 2015; Karraker & Young, 2007; Pinheiro et al., 2011; Teti & Crosby, 2012; Warren et al., 2006; Ystrom, Hysing, et al., 2017; Ystrom, Nilsen, et al., 2017). However, effect sizes reported in most of these studies are small and correlations are usually lower than .20.

Importantly, the majority of studies in this field have relied on maternal reports of both depressive symptoms and infant sleep outcomes. The sole reliance on parental (typically maternal) reports of both depressive symptoms and infant sleep constitutes a major limitation, because findings may be inflated by means of an informant confound. This may be especially relevant when considering the relations between maternal depression and child sleep, as evidence shows that maternal mental health symptoms, and specifically depression, may influence maternal perception of their child's behavior (De Los Reyes & Kazdin, 2005; Goldberg et al., 2013).

To the best of our knowledge, only three studies examined the links between maternal depressive symptoms and objective measures of infant sleep. In a study assessing infant sleep-wake patterns with videosomnography, mothers with higher depressive symptoms at one-month postpartum were more likely to have self-soothing infants at 12 months (Burnham et al., 2002). The authors suggested that these mothers might have been less likely to immediately respond to their infants' awakenings, thus giving the infants more opportunities to independently fall back to sleep. Another study that used actigraphy and sleep diaries found no significant associations between maternal prenatal depressive symptoms and infant sleep measures at 8 months (Newland et al., 2016). The third study found that greater postpartum maternal depressive symptoms were associated with more inconsistent total sleep duration, as assessed by actigraphy. However, no significant correlations with average sleep duration were found and sleep quality measures (awakenings) were not included (de Jong et al., 2016).

Previous research on maternal mental health and infant sleep has focused mainly on maternal depressive symptoms. Only a few studies have assessed other maternal emotional distress conditions, such as maternal anxiety and stress, and all of them were based on maternal reports of child sleep (Garthus-Niegel et al., 2018; Petzoldt et al., 2016). The only study that examined mothers with a clinical anxiety disorder during pregnancy and in the postpartum did not find support for a significant association with infant sleep (Petzoldt et al., 2016). Similarly to studies on maternal depressive symptoms, studies examining nonclinical samples found that prenatal anxiety symptoms (O'Connor et al., 2007), and postnatal symptoms of anxiety, stress, and PTSD symptoms were moderately associated with more sleep problems based on maternal reports (Garthus-Niegel et al., 2018; Goldberg et al., 2013; Hughes et al., 2015; Sharkey et al., 2016).

To summarize, although it is widely accepted in the literature that maternal depressive symptoms are predictive of infant sleep problems (Hiscock & Wake, 2001; Karraker & Young, 2007; Sadeh et al., 2010; Teti & Crosby, 2012; Warren et al., 2006; Ystrom, Nilsen, et al., 2017), the above review demonstrates that the evidence to support this claim is, in fact, limited. Whereas

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research based on clinical samples has demonstrated that mothers' prenatal clinical depression is a risk factor for infant sleep problems in the beginning of the infant's life, it is far less clear whether maternal depressive symptoms (prenatal or postnatal) act as a risk factor for the development of infant sleep disturbances. Studies based on objective sleep measures are scarce and the few that exist do not support this assumption. Most of the findings based on maternal reports demonstrate modest associations, and it could be the case that these associations are inflated by shared method variance. Moreover, there is almost no research on the role of maternal anxiety and stress in the development of infant sleep problems.

The Present Study

The present study was aimed at comprehensively investigating the longitudinal relations between maternal emotional distress (i.e., depressive symptoms, anxiety symptoms, and parenting stress) during pregnancy and postpartum and between infant sleep.

Because previous research has focused mainly on maternal depressive symptoms, our main goal was to examine the assumption that maternal depressive symptoms are directly associated with infant objective and subjective sleep disturbances. We hypothesized that we would find associations between maternal depressive symptoms and reported infant sleep, but based on our research review we did not expect to find statistically or substantively significant associations between maternal depressive symptoms and objectively assessed infant sleep. Beyond testing the simple associations which focused on the links between maternal emotional distress and infant sleep at specific time points, we also took advantage of the longitudinal nature of the study and aimed to examine, for the first time, whether we would find longitudinal relations between changes in maternal depressive symptoms from pregnancy to 18 months and between changes in infant sleep quality and duration (reported and objective) from 3 months to 18 months. We focused on the examination of the trajectories (i.e., slopes rather than the intercepts), because we were mainly interested in understanding whether patterns of change in maternal depressive symptoms (such as a deterioration in depression levels) across this critical time of transition to parenthood and the postpartum period would be associated with individual differences in infant sleep. We expected to find mild associations over time with reported infant sleep measures and no statistically or substantively significant links over time between maternal emotional distress and objective infant sleep.

Moreover, we aimed to test other aspects of maternal emotional distress in relation to infant sleep. Specifically, we examined maternal anxiety symptoms and maternal parenting-stress. Because prior literature on these factors in relation to infant sleep is very restricted, we treated these analyses as mainly exploratory.

Method

Participants

Two hundred twenty-six Israeli families were recruited during pregnancy through prenatal courses and announcements on Internet forums for expectant parents. The sample was enrolled during pregnancy to allow for the examination of the role of prenatal maternal emotional distress in the prediction of infant sleep problems. Inclusion criteria included two-parent families expecting their first child with a singleton full-term pregnancy. We only enrolled parents expecting their first child to minimize variance related to having prior experience with parenting. Post hoc exclusion criteria (of which parents were informed at the time of consent) were: (a) preterm birth (<37 weeks); (b) infant breathing-related problems; (c) persistent maternal or infant medical problems. Demographic characteristics (parental age and education) were collected during the third trimester of pregnancy (see Table 1). All participants were Jewish and mostly living in either the center or southern regions of Israel.

The study included five assessment points: at the third trimester of pregnancy, 3, 6, 12, and 18 months postpartum. The *N* for the third trimester of pregnancy and 3 months was 225, at 6 months, *N* was 191, at 12 months, *N* was 172, and at 18 months, *N* was 150. Three families did not participate at the six-month assessment and returned to the study at the 12-month assessment. Five families did not provide data at the 12-month assessment but returned to the study at the 18-month assessment (see Figure 1 – flowchart). Main reasons for discontinuation were lack of willingness to participate, overload at work or at home, moving abroad, and infant health problems. Moreover, the participation of seven families at 12 months and of sixteen families at 18 months was discontinued, because the study had ended in terms of funding. The families who withdrew from the study were compared with the participating families on sociodemographic variables and on the maternal emotional distress variables (i.e., symptoms of depression, anxiety, and parenting stress). No differences were found for any of these variables.

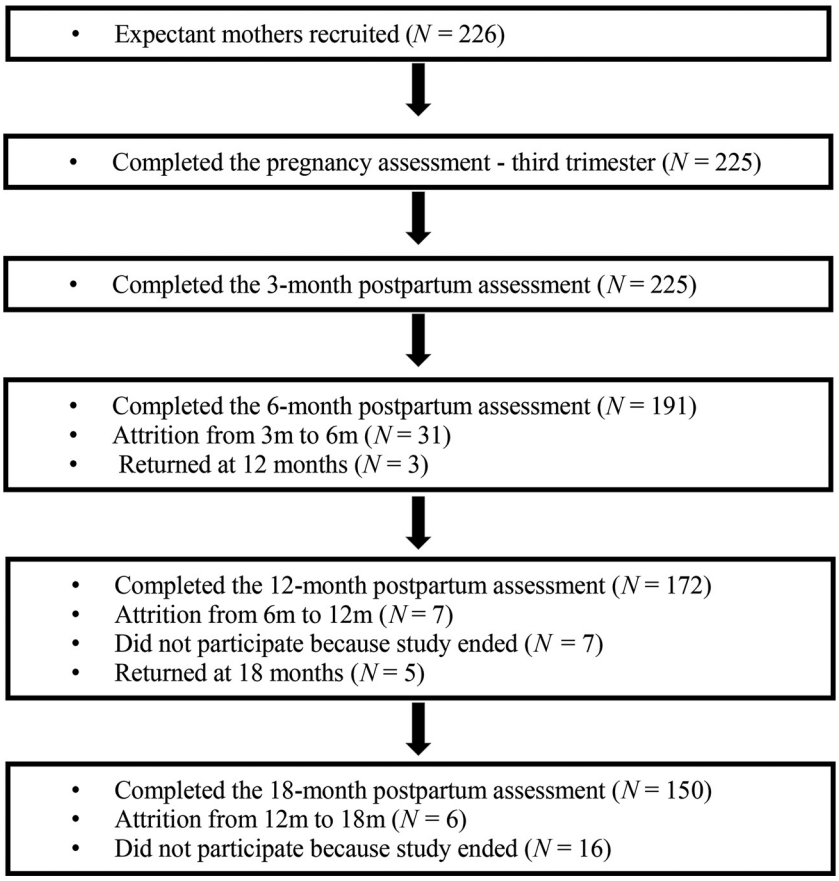
Procedure

The study protocol was approved by the Helsinki Ethical Review Board at Soroka Medical Center, which is affiliated with Ben-Gurion University of the Negev (study title "Maternal Emotional Distress and Infant Sleep Problems"; Protocol No. 5110). All parents signed informed consent before the first assessment and again at the three-month visit. At each assessment point (pregnancy, 3, 6, 12, and 18 months), a research assistant visited the participants and instructed them about the study's procedures (e.g., actigraphy use, questionnaires). We chose the age of 3 months as our starting point because, at this age, day–night circadian rhythms are already quite organized, allowing most parents to

Table 1
Sample Characteristics

Demographic	*M* ± *SD*	%
Mother's age (years)	28.81 ± 3.28	
Mother's education (years)	15.65 ± 2.02	
Father's age (years)	31.66 ± 7.04	
Father's education (years)	14.99 ± 2.32	
Gestational age—third trimester (weeks)	35.23 ± 1.31	
Maternal delivery week	39.26 ± 1.3	
Number of rooms at home	3.32 ± .92	
Infant weight 3 months (kg.)	5.88 ± .80	
Infant weight 6 months (kg.)	7.70 ± .95	
Infant weight 12 months (kg.)	9.45 ± 1.2	
Infant weight 18 months (kg.)	11.03 ± 1.1	
Child sex		50.5% boys

Figure 1
Study Flow Chart


• Expectant mothers recruited (N = 226)
• Completed the pregnancy assessment - third trimester (N = 225)
• Completed the 3-month postpartum assessment (N = 225)
• Completed the 6-month postpartum assessment (N = 191)
• Attrition from 3m to 6m (N = 31)
• Returned at 12 months (N = 3)
• Completed the 12-month postpartum assessment (N = 172)
• Attrition from 6m to 12m (N = 7)
• Did not participate because study ended (N = 7)
• Returned at 18 months (N = 5)
• Completed the 18-month postpartum assessment (N = 150)
• Attrition from 12m to 18m (N = 6)
• Did not participate because study ended (N = 16)

clearly define the beginning of the nocturnal sleep period (Galland et al., 2012; Mirmiran et al., 2003). This was important because our study focused on nighttime sleep and not on the 24-hr sleep–wake cycle. Infant sleep was assessed for five nights using actigraphy (Acebo et al., 1999). Sleep was assessed only on weekdays and only when the infant fell asleep at home. In addition, mothers completed the Brief Infant Sleep Questionnaire (BISQ) during the sleep assessment week. At all assessment points, mothers also completed questionnaires aimed at assessing depressive and anxiety symptoms severity, and, at all postpartum assessments, mothers completed a parenting-stress questionnaire. Upon completing each assessment, participants received a small gift (value of about $20) and a graphic report of their infant's actigraphic sleep.

Measures

Actigraphy

The actigraph is a small wristwatch-like device that is attached to the infant's ankle during the recording period. It registers motility data, which is translated into sleep–wake measures based on a computerized scoring algorithm (Sadeh et al., 1994). Actigraphy has been established as a nonintrusive, reliable method for studying continuous sleep-wake patterns in the infant's natural sleep environment (Sadeh, 2015; So et al., 2005). The validity of actigraphy against polysomnography and direct sleep observations has been demonstrated in various studies in the pediatric population (Bélanger et al., 2013; Sadeh et al., 1991; Sadeh et al., 1995; So et al., 2005). However, actigraphy has been criticized for its relatively low specificity (i.e., wake detection ability) with some devices and some scoring algorithms (Bélanger et al., 2013; Hall et al., 2015; Meltzer et al., 2012; Sadeh, 2011).

In the present study, we used the micromotion logger sleep watch (Ambulatory Monitoring Inc., Ardsley, NY), one of the most frequently used devices in the pediatric sleep field (Meltzer et al., 2012). Mothers were asked to attach the actigraph to their infants' ankle 15 minutes before they went to sleep and to remove it 15 minutes after they woke up, so that sleep onset and offset could be easily identified. Daily sleep diaries were completed during the assessment period and were used to identify artifacts and control the quality of the actigraphy data (e.g., exclude nights in which the device was removed from the child, or periods of externally induced motion).

At all assessment points, actigraphic raw data were first visually inspected and then translated into sleep measures with the Actigraphic Scoring Analysis (ASA) program based on Sadeh's validated and widely used scoring algorithm for infants (Meltzer et al., 2012; Sadeh et al., 1995). We applied the one-minute epoch

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interval according to the standard working mode for sleep–wake scoring which is the most commonly studied and reported epoch length (Meltzer et al., 2012). Sleep onset was defined as the first minute after reported bedtime that was identified as sleep by the ASA sleep-wake algorithm and that was followed by at least 15 minutes of uninterrupted sleep. Morning awakening time was defined as the last minute identified as sleep that was preceded by at least 15 minutes of uninterrupted sleep (Meltzer et al., 2012; Sadeh et al., 2000).

The sleep-wake measures used in the present study have been validated against polysomnography with agreement rates for sleep-wake identification higher than 90% (Sadeh et al., 1991, 1994, 1995). Actigraphic sleep measures included in the present study: (a) Night-Wakings (A-NW) – number of night-wakings that last for at least five minutes (and that were preceded and followed by at least 15 minutes of uninterrupted sleep). The ≥5 minutes interval is a frequently used nocturnal wake period to identify awakenings (Meltzer et al., 2012; Sadeh et al., 2000); (b) Sleep minutes (A-SMIN) – true sleep time (excluding nighttime wakefulness); (c) Sleep percent (A-SP) – percent of true sleep time (excluding nighttime wakefulness) from total sleep period (including nighttime wakefulness). All measures were averaged across the monitoring period.

Most infants had valid actigraphy data for the full five assessment nights in all study phases. However, because of technical problems (e.g., actigraph fell off in the middle of the night), some data were missing. Thus, at 3 months, we had 5 nights of actigraphy data for 70.3% of the infants; 4 nights for 21.2%; and 3 nights for 8.5%. At 6 months, the rates were: 5 nights – 63.0%; 4 nights – 23.8%; and 3 nights – 13.2%. At 12 months, the rates were: 5 nights – 75%; 4 nights – 22.7%; and 3 nights – 2.3%. Last, at 18 months, the rates were: 5 nights – 67.3%; 4 nights – 20.4%; and 3 nights – 12.3%. Although at least 5 days of monitoring are recommended for obtaining reliable measures, fewer days have been reported in many studies with reasonable reliability as well (Acebo et al., 1999; Sadeh, 2015). We preferred to minimize disqualification of data and thus retained the actigraphic assessments of three to four nights, after ensuring that the mean scores of actigraphic measures for infants with fewer than five nights were not significantly different than those who were assessed for five nights.

Brief Infant Sleep Questionnaire

The BISQ is a well-validated questionnaire aimed at assessing infants' averaged sleep patterns (Sadeh, 2004). Parents are instructed to refer to the infant's sleep patterns in the present. The derived measures for the purpose of the current study were: (a) Night-wakings (B-NW) – number of night-wakings of any length; (b) Sleep duration (B-SH) – number of hours asleep; and (c) Sleep problems (B-SP) – subjective parental perception of sleep problems ("Do you consider your child's sleep as a problem?"; 1 = *not at all* to 5 = *very much*).

In addition, the BISQ was used to obtain information about infants' sleeping arrangements (which was treated in the present study as a covariate variable). Mothers were asked to indicate where their infant sleeps during the night: (a) Infant crib in a separate room (solitary sleeping); (b) Infant crib in the parent's room (room-sharing); (c) parents' bed. Because there were almost no bed-sharing infants in our sample and there were no significant differences for the infant sleep measures between bed-sharing and room-sharing (without bed-sharing) infants, we combined these two groups into one group, referred to as "room-sharing" infants. The percentage of room-sharing infants (opposed to solitary-sleeping infants) across phases was as follows: at 3 months – 78.5%, at 6 months – 52.4%, at 12 months – 27%, and at 18 months – 25.2%.

The Edinburgh Postnatal Depression Scale

The Edinburgh Postnatal Depression Scale (EPDS) is a widely used screening tool for postpartum depression (Cox et al., 1987) and has been validated for use during pregnancy (Bergink et al., 2011). It consists of 10 short statements addressing maternal depressive symptoms during the past week. Each item is rated on a 4-point scale (0–3), and the total score ranges from 0 to 30 with higher scores indicating higher maternal depressive symptoms. The cut-off score for depression is ≥13, whereas a threshold of 10 is commonly used in community samples to detect minor depression (Cox et al., 1987; Khanlari et al., 2019). In the present sample, Cronbach's alpha ranged from .77 to .80 for the five assessment points. At the pregnancy assessment, 18 women scored in the 10–12 "minor depression" range and nine met the clinical cut-off score of ≥13. At 3, 6, 12, and 18 months postpartum, the number of mothers having a 10–12 "minor depression" score was nine, seven, four, and five, respectively, and the number of mothers scoring ≥13 was two, five, three, and three, respectively.

The State–Trait Anxiety Inventory

The State–Trait Anxiety Inventory (STAI; Spielberger et al., 1983) is a well-established questionnaire for the assessment of trait and state anxiety levels. In the present study, we used only the trait version, because we were interested in assessing the general level of maternal anxiety during each assessment point (rather than acute/"this moment" anxiety).

The trait version includes 20 items that are summed for a total score. Each item is rated on a 4-point scale (1–4), and the total score ranges from 20 to 80, with higher scores indicating higher trait anxiety symptoms. Cronbach's alpha ranged from .89 to .92 for the five assessment points.

The Parenting Stress Index/Short Form (PSI/SF)

The Parenting Stress Index (PSI; Abidin, 1995) is a widely used questionnaire measuring stress in the parent–child dyad. The short form (PSI/SF) includes 36 items and has three subscales: (a) the degree of distress a parent is experiencing in the parental role; (b) the parent's expectations of his or her infant; and (c) the behavioral characteristics of the child. For the purpose of the present study, a total PSI score, based on all 36 items, was calculated. Items are rated on a 5-point scale (1–5), and the total score ranges from 36 to 180, with higher scores indicating higher parenting stress symptoms. Cronbach's alpha ranged from .90 to .92 for the four postpartum assessment points.

Background Questionnaires

Parents completed background questionnaires to collect sociodemographic and developmental data, including parental age, education, number of rooms at home (completed during pregnancy), infant gender, infant weight, and nighttime breastfeeding

(completed at each postpartum assessment). Nighttime breastfeeding was assessed with one question asking the mother to indicate how often she uses breastfeeding to soothe the infant during the night on a 5-point scale, ranging from 1 (*never*) to 5 (*frequently*).

Analysis Plan

We first calculated partial Pearson correlations (controlling for sleeping arrangements and nighttime breastfeeding) between the three maternal emotional distress variables (depression, anxiety, and stress) and the six infant-sleep variables (A-NW, A-SMIN, and A-SP, measured by actigraphy; and B-NW, B-SH, and B-SP, measured by the BISQ) at each assessment point.

We then conducted bivariate latent trajectory analyses (LTAs) for each combination of maternal emotional distress variable and infant-sleep variable for a total of 18 models. Nominal time relative to birth was used for the trajectory slopes: 1 month prepartum (for maternal depression and anxiety) and 3, 6, 12, and 18 months postpartum (for all variables). Models were estimated in Mplus v.8.0 (Muthén & Muthén, 2017) using the "MLR" estimator to address missing data. MLR is a maximum likelihood (ML) estimator that provides standard errors and fit statistics that are appropriate for nonnormally-distributed data. ML estimation is a standard technique in structural equation modeling that enables the use of all available data from all cases, regardless of missing variables, to maximize statistical power. The results are unbiased when data are missing at random (MAR), a less restrictive assumption than that required for listwise deletion; it also better retains power (Little & Rubin, 1989). We included linear and quadratic slopes with respect to time for most variables. For two BISQ variables—B-NW and B-SP—the quadratic polynomial models did not fit the data well and we used latent basis models (McArdle & Epstein, 1987). We covaried maternal and paternal age and education and infant gender in all models. Each model included all other study variables (i.e., maternal distress and infant sleep variables) as Mplus "auxiliary" variables for purposes of the ML accommodations for missing data.

The key test of interest in each model was whether the growth parameters of maternal emotional distress would predict the latent growth (linear and quadratic) parameters of infant sleep. We evaluated these tests using the Wald statistic, which in this case is distributed as χ^2 with 4 degrees of freedom (for the four coefficients being tested, or two in the case of the basis models). Where the Wald test was not significant, we assessed our power to reject the null hypothesis (that assumes "close fit" between a model without paths allowing effects of depression on sleep and a model with the paths allowing such effects), using the criterion of root mean squared error of approximation (RMSEA) $< .05$. For this, we used R v3.4.1 to execute code based on that of Preacher and Coffman (2006; May). When our unconstrained model (i.e., a model with paths allowing effects of depression on sleep) did not have high power ($\geq .80$) to reject close fit, we calculated the minimum RMSEA which we could reasonably have anticipated rejecting (again, power $\geq .80$). In other words, this would mean, in line with the null hypothesis, that a model without paths between maternal emotional distress and infant sleep would have an acceptable fit.

Results

Preliminary Analyses

Descriptive statistics of all study variables at the different assessment points are presented in Table 2. Pearson correlations between the three emotional distress variables are shown in Supplementary Table S-1 in the online supplemental materials. Overall, the concomitant correlations at the different assessment points between the EPDS and STAI scores ranged from $r = .59$ to $r = .72$. The concomitant correlations between the EPDS and PSI scores ranged from $r = .40$ to $r = .57$, and the concomitant correlations between the STAI and PSI scores ranged from $r = .55$ to $r = .59$. Although these correlations are in the moderate-high range, we decided to examine the three distress variables separately and not to combine them into an "emotional distress" factor, because the main aim of the present study was to examine the links between depressive symptoms and infant sleep, as has been done in previous studies. Also, we preferred to separately examine the role of anxiety and parenting stress which have hardly been studied before in relation to infant sleep.

Pearson correlations between infant sleep measures and nighttime breastfeeding are shown in Supplementary Table S-2 in the

Table 2

Descriptive Statistics (Means, Standard Deviations and Range) of Maternal Emotional Distress and Infant Sleep Measures

	Pregnancy		3M		6M		12M		18M	
Measure	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)	Range
EPDS	4.72 (3.78)	0–15	3.67 (3.19)	0–15	3.57 (3.42)	0–18	2.83 (3.19)	0–17	3.27 (3.51)	0–17
STAI	31.1 (7.09)	20–58.2	30.1 (7.79)	20–65.5	30.1 (8.0)	20–65.5	29.9 (7.23)	20–60.0	30.4 (7.81)	20–63.6
PSI			58.5 (15.41)	36–109	58.1 (14.06)	36–99.4	58.3 (14.02)	36–109	60.0 (15.81)	36–123.4
Act-Smin			563 (68.30)	312.7–719.2	578 (49.05)	371.5–678.3	596 (42.62)	449.7–725.0	570 (64.22)	303.3–707.0
Act-NW			2.73 (1.23)	0.2–5.8	2.23 (1.39)	0–6.8	1.53 (1.08)	0–6.0	0.97 (0.80)	0–4.0
Act-SP			92.22 (3.65)	79.2–99.5	93.62 (3.48)	82.3–99.8	96.59 (3.0)	85.0–99.6	97.30 (2.05)	90.9–99.8
BISQ-SH			9.07 (1.59)	4–12.5	9.72 (1.31)	6–13	10.07 (1.44)	3.5–12	10.28 (0.85)	8–12
BISQ-NW			1.73 (1.09)	0–6	2.29 (1.44)	0–6	1.77 (1.29)	0–7	1.29 (1.12)	0–6
BISQ-SP			1.49 (0.79)	1–5	1.86 (0.93)	1–4	1.69 (0.89)	1–4	1.60 (0.91)	1–4

Note. EPDS = The Edinburgh Postnatal Depression Scale; STAI = State-Trait Anxiety Inventory; PSI = The Parenting Stress Index/short form; Act-Smin = actigraphic true sleep time (excluding nighttime wakefulness); Act-NW = number of actigraphic night-wakings lasting at least 5 min; Act-SP = percentage of actigraphic true sleep time from total sleep period; BISQ = Brief Infant Sleep Questionnaire; BISQ-SH = BISQ number of hours asleep; BISQ-NW = BISQ number of night-wakings of any length; BISQ-SP = BISQ sleep problem ("Do you consider your child's sleep as a problem?").

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online supplemental materials, and ANOVA testing the differences in infant sleep between room-sharing and solitary sleeping infants appear in Supplementary Table S-3 in the online supplemental materials. Because significant links were found between some of the infant sleep measures and between nighttime breastfeeding and sleeping arrangements, these variables were controlled for in subsequent Pearson correlation analyses of the associations between maternal emotional distress and infant sleep (see Table 3).

Pearson Correlations Between Maternal Emotional Distress and Infant Sleep

Partial Pearson correlations (controlling for sleeping arrangements and nighttime breastfeeding) were calculated between the three maternal emotional distress variables (i.e., EPDS, STAI, PSI) and the six infant sleep variables (Actigraph night-wakings—A-NW, Actigraph sleep minutes—A-SMIN, Actigraph sleep percent—A-SP, BISQ night-wakings—B-NW, BISQ sleep duration—B-SH, and BISQ sleep problems—B-SP) at all assessment points. These correlations are displayed in Table 3.

There were no significant correlations (all $ps > .05$) between any of the maternal emotional distress measures and the actigraphic sleep measures. As for the reported measures of infant sleep (BISQ measures), significant consistent correlations were found between maternal emotional distress variables (especially PSI) and mothers' subjective perception of infant sleep problems (B-SP). These correlations ranged between $r = .16$ and $r = .46$. There were no significant correlations with the quantified measures of the BISQ (B-NW and B-SH).

Univariate Models

We estimated univariate LTAs for each of the three maternal emotional distress variables, three actigraphy measures, and three BISQ variables. In each model we covaried parental age and education, and child gender (from the original sample of 225 families, 61 were omitted for missing data on the exogenous covariates, for an analysis sample of $n = 165$). Quadratic variables fit the data well with nonsignificant χ^2 tests of absolute fit ($ps > .05$, see Supplementary Table S-4 in the online supplemental materials) for seven of the nine variables. For B-NW and B-SP, we used latent basis models for better fit. The parameter estimates are shown in Supplementary Table S-4 in the online supplemental materials. Time was scaled to the unit of year and intercept of 0 at birth, resulting in linear-slope loadings of −.83 (one-month prepartum) to 1.5 (18-months postpartum). The model-implied values of each variable at each observed time appear in Supplementary Table S-5 in the online supplemental materials, with the raw-data values (not adjusted for MAR) for comparison.

Bivariate Models—Changes in Maternal Emotional Distress Predicting Changes in Infant Sleep

We next conducted bivariate LTA models for each pairwise combination of maternal emotional distress variable and infant sleep variable, for a total of eighteen models estimated. Seventeen of the eighteen models bivariate fit the data well by χ^2, $ps > .05$; the remaining model (link between EPDS and A-SMIN), fit the data well enough, $\chi^2(33) = 47.48$, $p = .049$, for us to decide to move forward without a change of strategy. All fit tests are shown in in the left-hand portion of Table 4. The key question of interest was whether changes in maternal emotional distress variables (i.e., linear and quadratic slope latent variables) would predict changes in infant sleep (i.e., linear and quadratic slope latent variables or latent basis magnitudes). Latent intercepts were not included in the hypothesis tests because of our focus on longitudinal changes. All 18 Wald tests were nonsignificant, $ps > .05$, indicating no significant effects of changes in maternal distress on changes in infant sleep (parameter estimates in right-hand portion of Table 4).

Post Hoc Power Analysis

Given the lack of significant effects, we considered whether to tentatively accept the null hypotheses or consider the results inconclusive. Because we hypothesized null effects (for the actigraphic measures), we used post hoc power analysis based on the power to reject the null hypothesis (i.e., a population RMSEA greater than each constrained model's estimated RMSEA). For six of the eighteen models (those with power in bold type in the center section of Table 4), we had enough statistical power to reject the null hypothesis (i.e., power of at least .85 to reject a population RMSEA of the constrained model of .05; MacCallum et al., 1996). This was consistent with our hypothesis for the actigraphic measures (no effect of maternal distress on actigraphic measures). For the remaining twelve of the eighteen models, we derived the population RMSEA for which we would have had at least .80 power to reject the null hypothesis. These RMSEA values ranged from .052 to .067, *Median* = .058 (see Table 4), all well within MacCallum et al. (1996) criteria of .08 for mediocre fit. Broadly speaking, we had sufficient power to reject the null hypotheses for these 12 models as well. We inferred from these calculations that the obtained nonsignificant effects of changes in maternal emotion on changes in infant sleep were not attributable to lack of power to reject the null hypotheses.

Discussion

This study examined for the first time the links between maternal symptoms of depression, anxiety, and parenting stress and between infant objective and subjective sleep, from pregnancy to 18 months postpartum. The longitudinal design afforded a unique opportunity to examine whether changes in maternal emotional distress explain changes in infant sleep over time. Based on a comprehensive literature review of studies that examined the links between maternal depressive and anxiety symptoms and infant sleep in community/cohort studies (Goldberg et al., 2013; Gress-Smith et al., 2012; Gueron-Sela et al., 2017; Hughes et al., 2015; Karraker & Young, 2007; Warren et al., 2006; Ystrom, Hysing, et al., 2017), we hypothesized that maternal emotional distress would be associated with maternal reports of infant sleep, but not with objectively assessed infant sleep.

First, our analyses included an examination of the partial correlations (controlling for nighttime breastfeeding and sleeping arrangements) between maternal symptoms of depression, anxiety, and parenting stress and between the infant sleep measures, which included both objective (actigraphic) measures and maternal reported measures of sleep duration and sleep quality. These

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Table 3

Pearson Correlations (Controlling for Sleeping Arrangements and Nighttime Breastfeeding) Between Maternal Emotional Distress and Infant Sleep

Measure	EPDSPreg	EPDS3m	EPDS6m	EPDS12m	EPDS18m	STAIPreg	STAI3m	STAI6m	STAI12m	STAI18m	PSI3m	PSI6m	PSI12m	PSI18m
Act-Smin_3m	.13	.00	.07	.06	.17	.01	.02	.03	.04	.11	−.10	−.10	−.09	.01
Act-NW_3m	.02	.05	.03	.08	.00	.00	−.03	−.04	.04	.02	.04	−.02	−.01	−.06
Act-SP_3m	−.01	−.03	−.02	−.05	−.03	−.01	.03	.02	−.10	−.02	−.04	−.07	−.05	−.01
BISQ-SH_3m	.06	.01	.03	−.05	.11	−.03	.05	.02	.00	.08	.02	.03	.02	.12
BISQ-NW_3m	.06	.12	.06	.02	.10	.08	.03	.06	.04	.10	−.02	−.02	.06	.04
BISQ-SP_3m	.11	.17	.10	.12	−.02	.16*	.17	.27**	.15	.15	.46***	.40***	.26**	.21*
Act-Smin_6m	.12	.10	.06	.17	.11	.06	.11	.09	.17	.20	.05	.01	−.01	.08
Act-NW_6m	.05	.01	−.09	−.02	.04	−.00	−.03	−.01	.03	.16	.13	.13	.04	.11
Act-SP_6m	−.10	−.13	−.01	−.07	−.06	−.05	−.05	−.07	−.15	−.23*	−.17*	−.11	−.04	−.11
BISQ-SH_6m	.14	.16	.12	−.11	.12	.09	.14	.11	.14	.14	.14	.09	.01	.06
BISQ-NW_6m	−.03	.06	−.05	−.12	−.04	−.03	−.09	−.05	−.10	.01	.04	.13	.11	.09
BISQ-SP_6m	.12	.27**	.25*	.16	.16	.10	.18	.19	.10	.23*	.34***	.35***	.26*	.32**
Act-Smin_12m	.02	−.14	−.07	−.03	−.04	−.01	−.02	−.04	−.01	.10	−.12	−.12	−.14	−.11
Act-NW_12m	.02	.03	−.01	.12	.00	−.02	−.00	−.11	.08	−.02	.06	.11	.05	.05
Act-SP_12m	−.13	.04	.04	.02	.08	.03	−.04	.00	.03	.12	.02	−.02	.07	.05
BISQ-SH_12m	.03	.09	.06	.06	.06	−.01	.07	.04	.15	.16	−.01	−.08	−.14	−.02
BISQ-NW_12m	.02	−.00	−.10	−.12	−.05	.03	−.13	−.06	−.07	−.06	.01	.05	.13	.07
BISQ-SP_12m	.16*	.22*	.09	−.00	.08	.13	.07	.14	.06	−.04	.26**	.34**	.33**	.32**
Act-Smin_18m	−.06	−.03	−.03	.08	−.04	−.09	−.05	−.07	.07	.00	−.04	−.08	−.00	−.10
Act-NW_18m	.03	−.04	−.11	−.07	−.09	−.11	−.09	−.05	−.07	−.13	−.16	−.03	−.13	−.10
Act-SP_18m	−.13	.04	.04	.02	.08	.03	−.04	.00	.04	.12	.02	−.02	.02	.05
BISQ-SH_18m	.02	.02	.08	.18	.01	−.07	.04	−.03	.13	.13	−.09	−.12	−.09	−.04
BISQ-NW_18m	.02	.04	−.02	−.04	.00	−.09	−.09	−.04	−.12	.01	−.05	−.01	.07	.09
BISQ-SP_18m	.16	.09	.08	.24*	.12	.11	.22*	.26**	.08	.11	.09	.19	.26**	.26**

Note. EPDS = The Edinburgh Postnatal Depression Scale; STAI = State-Trait Anxiety Inventory; PSI = The Parenting Stress Index/short form; Act-Smin = actigraphic true sleep time (excluding nighttime wakefulness); Act-NW = number of actigraphic night-wakings lasting at least 5 min; Act-SP = percentage of actigraphic true sleep time from total sleep period; BISQ = Brief Infant Sleep Questionnaire; BISQ-SH = BISQ number of hours asleep; BISQ-NW = BISQ number of night-wakings of any length; BISQ-SP = BISQ sleep problem ("Do you consider your child's sleep as a problem?").

* $p < .05$. ** $p < .01$. *** $p < .001$.

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Table 4

Model Fit, Power, and Key Parameter Estimates From Bivariate Models

Mother distress predictor	Infant sleep outcome	Model fit chi-square	Model fit Df	Model fit *p*	Wald chi-square	Wald *df*	Wald *p*	Est. RMSEA	RMSEA 90% CI Lower bound	RMSEA 90% CI Upper bound	Constrained model RMSEA	Power to reject constrained model	Emotion linear slope to sleep linear slope (*SE*)[a]	Emotion linear slope to sleep quadratic slope (*SE*)	Emotion quadratic slope to sleep linear slope (*SE*)[a]	Emotion quadratic slope -> sleep quadratic slope (*SE*)
EPDS	Act-Smin	47.48	33	0.049	2.09	4	0.720	0.052	0.003	0.082	0.067	0.824	−21.2	12.8	−47.6	25.0
													81.7	44.8	148.8	81.6
	Act-SP	34.73	33	0.386	2.47	4	0.651	0.018	0.000	0.061	**0.050**	**0.850**	0.26	0.39	0.59	0.50
													5.41	2.48	9.92	4.54
	Act-NW	38.98	33	0.219	0.66	4	0.956	0.033	0.000	0.069	0.055	0.819	1.14	−0.80	2.14	−1.47
													3.04	1.95	5.50	3.54
	BISQ-SH	43.12	33	0.112	3.85	4	0.427	0.043	0.000	0.076	0.061	0.823	−1.01	0.53	−2.36	1.18
													2.08	1.02	3.77	1.84
	BISQ-NW	57.39	43	0.070	0.49	2	0.782	0.045	0.000	0.073	0.057	0.803	−0.051		−0.098	
													0.085		0.152	
	BISQ-SP	48.02	43	0.277	0.28	2	0.871	0.027	0.000	0.061	**0.050**	**0.915**	0.041		0.081	
													0.110		0.205	
STAI	Act-Smin	44.90	33	0.081	0.69	4	0.952	0.047	0.000	0.079	0.063	0.807	−13.8	9.3	−5.4	3.3
													26.8	14.8	50.6	27.4
	Act-SP	30.88	33	0.573	0.88	4	0.927	0.000	0.000	0.052	**0.050**	**0.895**	0.67	0.09	1.76	−0.08
													2.09	0.77	3.80	1.50
	Act-NW	29.79	33	0.628	1.13	4	0.889	0.000	0.000	0.049	**0.050**	**0.895**	0.25	−0.23	0.34	−0.39
													0.52	0.33	0.99	0.62
	BISQ=SH	46.02	33	0.066	1.96	4	0.744	0.049	0.000	0.080	0.065	0.825	0.23	−0.11	−0.11	0.06
													1.24	0.65	2.79	1.46
	BISQ-NW	53.49	43	0.131	0.26	2	0.880	0.038	0.000	0.068	0.052	0.806	−0.072		−0.170	
													0.207		0.438	
	BISQ-SP	47.69	43	0.288	0.32	2	0.851	0.026	0.000	0.060	**0.050**	**0.922**	0.024		0.055	
													0.073		0.147	
PSI	Act-Smin	18.68	19	0.477	2.44	4	0.655	0.000	0.000	0.067	0.057	0.812	−5.15	3.77	−5.93	5.26
													8.07	4.55	14.24	8.11
	Act-SP	15.50	19	0.690	2.07	4	0.723	0.000	0.000	0.054	0.057	0.812	0.188	−0.145	0.199	−0.176
													0.348	0.196	0.607	0.331
	Act-NW	18.42	19	0.495	1.71	4	0.789	0.000	0.000	0.066	0.057	0.812	−0.038	0.034	−0.053	0.048
													0.106	0.057	0.171	0.092
	BISQ-SH	19.35	19	0.435	2.60	4	0.627	0.011	0.000	0.069	0.058	0.814	0.027	0.009	0.116	−0.023
													0.136	0.072	0.2,412	0.121
	BISQ-NW	30.40	29	0.395	0.62	2	0.734	0.017	0.000	0.063	**0.050**	**0.864**	0.0,021		0.0,010	
													0.0,074		0.0,116	
	BISQ-SP	37.78	29	0.127	0.39	2	0.823	0.043	0.000	0.078	0.061	0.820	0.0,019		0.0,007	
													0.0,090		0.0,119	

Note. EPDS = The Edinburgh Postnatal Depression Scale; STAI = State-Trait Anxiety Inventory; PSI = The Parenting Stress Index/short Form; Act-Smin = actigraphic true sleep time (excluding nighttime wakefulness); Act-NW = number of actigraphic night-wakings lasting at least 5 min; Act-SP = percentage of actigraphic true sleep time from total sleep period; BISQ = Brief Infant Sleep Questionnaire; BISQ-SH = BISQ number of hours asleep; BISQ-NW = BISQ number of night-wakings of any length; BISQ-SP = BISQ sleep problem ("Do you consider your child's sleep as a problem?"). In bold – models for which we had enough statistical power to reject the null hypothesis.

[a] Predicting Magnitude of Latent Basis Changes for BISQ-NW and BISQ-SP.

analyses revealed significant correlations between maternal emotional distress and maternal reports of infant sleep, but there were no significant associations with the actigraphic measures. These findings correspond with the few studies on maternal depressive symptoms and infant sleep that included objective measures of infant sleep (de Jong et al., 2016; Newland et al., 2016). Moreover, both prenatal emotional distress and postpartum emotional distress were associated only with the mother's subjective rating of the sleep problems ("Do you consider your child's sleep as a problem?"), whereas the quantified measures (maternal reports of sleep duration and number of night-wakings) were not significantly associated with maternal emotional distress.

The fact that the only sleep variable associated with the emotional distress measures in the present study was the overall rating of sleep problems, whereas no associations with actigraphic variables or quantified reported measures were found, may suggest that the item "do you consider your child's sleep as a problem" is tapping into facets of sleep that were not assessed in this study such as sleep onset latency and difficulty self-soothing after a night-waking. Another possible explanation that could be inferred from this finding is that mothers experiencing higher emotional distress are more likely to perceive their infant's sleep as problematic, irrespective of the infant's actual nocturnal wakefulness, because of their own emotional difficulties. It could also be that these mothers are more alert during the night and thus are more likely to interpret the infant's natural activity during sleep (vocalization, change in position) as restless sleep or as a sleep problem.

The associations between maternal emotional distress and mother's ratings of infant sleep problems were overall consistent across the three emotional distress measures (i.e., depressive symptoms, anxiety symptoms, and parenting stress). However, among these three variables, maternal stress seemed to be more consistently and strongly related to perceived sleep problems (rs $>$.19 and $<$.46), in comparison to depressive and anxiety symptoms (rs $>$.16 and $<$ .27). These findings suggest that mothers with parenting stress symptoms, are especially more likely to experience their infant's sleep as problematic.

Comparing our findings with previous studies that have focused mainly on maternal depressive symptoms, a quite similar pattern emerged. In line with previous studies on *prenatal* depressive symptoms and infant sleep (Morales-Muñoz et al., 2018; Netsi et al., 2015; O'Connor et al., 2007; Toffol et al., 2019), some of the correlations in the present study between depressive/anxiety symptoms during the third trimester of pregnancy and perceived infant sleep problems were statistically significant but weak (rs = .16). Likewise, the highest correlations in the postpartum period between depressive/anxiety symptoms and perceived infant sleep problems was .27 (controlling for nighttime breastfeeding and sleeping arrangements). This is in line with most prior studies reporting significant but weak-moderate correlations between maternal mental health symptoms and reported infant sleep problems (Goldberg et al., 2013; Karraker & Young, 2007; Morales-Muñoz et al., 2018; Warren et al., 2006; Ystrom, Hysing, et al., 2017), although a few studies did find evidence for stronger links (Hiscock & Wake, 2001; Teti & Crosby, 2012). Overall, in correspondence with most previous studies in this field, it seems that the findings of the present study face two important restrictions: The first is that the effect sizes are overall low, and the second is that these findings may merely reflect shared method variance, as mothers reported both on their own symptoms and on their infant's sleep.

To examine our assumptions more rigorously, we conducted bivariate LTA that allowed assessing whether changes over time in each of the maternal emotional distress variables predict changes over time in infant sleep measures. As far as we know, this was the first study that implemented LTA in the context of a longitudinal study on maternal emotional distress and infant sleep. The results demonstrated no evidence for significant relations between any of the emotional distress variables and any of the sleep measures. Our next question was whether these null effects may have resulted from a problem of lack of statistical power to reject the null hypothesis. In other words, given the lack of significant effects, we considered whether to cautiously accept the null hypotheses (if there would be enough statistical power) or consider the results inconclusive (in case of lack of power). To this end, we conducted post hoc power analyses. The findings of these analyses revealed that there was enough power to reject the null hypothesis. Therefore, it seems that the null effects were not related to a statistical power problem and that the conclusion may be that our findings do not support the assumption that changes over time (from pregnancy to 18 months) in maternal emotional distress symptoms predict changes over time (from 3 to 18 months) in infant objective and subjective sleep. It might be possible to argue that the levels of emotional distress in our sample were insufficient to find an effect. Nevertheless, it seems that this was not the case, because the sample did include mothers with subclinical symptoms, and the rates of emotional distress and the level of variability were comparable with previous studies in this field (Goldberg et al., 2013; King et al., 2020; Netsi et al., 2015).

Nevertheless, the results of this study should be considered in light of several limitations. Our sample was relatively homogeneous as it included only first-born, typically developing infants, and most families represented the middle-upper socioeconomic class in Israel. Although these characteristics may restrict the generalizability of our findings, they may enhance the internal validity of the study. Also, our sample was community-based and did not include women with clinical depression. However, given the substantial proportion of women in the population who experience subclinical symptoms of postpartum depression and anxiety (Affonso et al., 1992; Kingston et al., 2018), understanding the correlates and implications of their distress, as well as aspects of their resilience, is highly important. In addition, the actigraphic assessment at each time point included five nights of monitoring, the minimum recommended for attaining reliable sleep measures (Acebo et al., 1999). More nights might have led to better quality sleep data. Moreover, we used the trait scale of the STAI, which probably measured a relatively stable characteristic and may not be sensitive enough to capture present pregnancy or postpartum related anxiety of women. Furthermore, the only assessment point during pregnancy was the last trimester. Additional research is needed to examine whether the timing of emotional distress during pregnancy may be differentially associated with infant sleep outcomes. Finally, we examined emotional distress symptoms singly. However, we cannot rule out the possibility that maternal emotional distress symptoms may interact with other environmental stressors (such as low socioeconomic status, low partner/social support) or other infant intrinsic factors (e.g., temperament) and that the interaction between these risk factors does play a role in

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predicting infant sleep problems (de Jong et al., 2016; Gueron-Sela et al., 2017; Netsi et al., 2015). Thus, an important next step for future research is to assess additional risk factors and to conduct moderation analyses.

Conclusions

Our findings suggest that mothers with higher emotional distress symptoms—and especially those with parenting stress symptoms—are more likely to experience their infant's sleep as problematic. These findings are in line with previous studies' findings (Goldberg et al., 2013; Karraker & Young, 2007; Morales-Muñoz et al., 2018; O'Connor et al., 2007; Warren et al., 2006). However, the findings of the present study challenge the assumption that maternal emotional distress is associated concomitantly and longitudinally with objective and subjective quantified facets of infant sleep (e.g., sleep minutes, number of night-wakings). Importantly, stringent statistical analyses were conducted to reach this null effect conclusion.

In terms of clinical implications, the findings suggest that an important focus of clinical work with emotionally distressed mothers seems to be adjusting and modifying their sleep-related cognitions and interpretations, rather than focusing on changing the sleep of their infants. Parents with heightened emotional distress may especially benefit, for instance, from early psych-education programs that teach parents about the development of infant sleep-wake patterns, address parental concerns, and help parents to reframe expectations regarding their infant sleep-related behaviors and nighttime sleep consolidation (Sadeh, 2005; Tikotzky & Sadeh, 2009).

Moreover, our findings may tentatively suggest that mothers from middle to upper socioeconomic status who experience moderate emotional distress could be reassured that their symptoms will probably not have an influence on their infants' sleep quality and duration. We believe that attributing inflated impact to maternal depressive and anxiety symptoms on infant sleep development may unnecessarily undermine new mothers who, in addition to the difficulties arising with the transition to parenthood, cope with emotional distress symptoms.

Importantly, the findings of the present study are based on a nonclinical sample and therefore our conclusions are restricted to mothers with mild to moderate emotional distress symptoms and are not relevant to mothers who experience significant distress or major clinical depression. Previous studies have demonstrated that clinical depression is predictive of infant objective sleep disturbances.

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